AN ECOLOGICAL STUDY OF THE NEW JERSEY STRAND FLORA.

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The development of the Atlantic sea coast from Maine to Virginia, and especially of the coastal lands of New Jersey, as places of summer resort has rendered a botanical survey of the shore line an imperative necessity. With the rise of towns and cities and the building of railroads, the primitive condition of the sea beaches has been remarkably changed. Dunes have been leveled, marshes have been filled in, old drainage areas have been removed, new soil has been brought to cover the sand formations to prevent their drifting, and these alterations have not failed to produce corresponding changes in the vegetation. New plants, weeds and the like, able, as well as the native plants, to withstand the saline conditions of air and soil, have been introduced with the coming of man as a permanent habitant; the old vegetation has been gradually removed, or, no longer able to grow under the altered conditions, has given place to the emigrants distributed by the aid of human beings.

Recognizing these facts, the present study of the sea-beach flora of New Jersey was undertaken by the writer, so as to preserve in some permanent form a record of the plant life, the distribution of the peculiar vegetation and the ecological relationships of the plants before the rapid change of the old conditions rendered impossible such an ecological survey. The material for this paper has been collecting for a number of years. As far back as 1894 the writer began his observations on the sea-beach flora, but during the present season (1900) the major part of the facts recorded here were gathered to form this permanent record.

During the summer's field work a number of places were visited along the Jersey coast, so as to make the account of the coastal flora as comprehensive as possible. The most exact reconnoissance was made at Seaside Park, Ocean County, where the writer has summered for a number of seasons, so that Barnegat Beach is

taken as typical, and the beaches of other situations visited (South Atlantic City, Ocean City and Wildwood) are chosen as modifying or strengthening the conclusions reached by a close study during several seasons of the salt-strand formations at Seaside Park, N. J. The choice of Barnegat Beach as a typical sea strand is not an arbitrary one. Of all the beaches visited, it conforms most closely to the ideal beach formation, and presents in its southern extension the coastal vegetation undisturbed by the hand of man, and in a condition as nature has left it.

While the collection of material was under way, a very important and instructive paper[1] appeared from the pen of Thomas H. Kearney, Jr., dealing with the plant covering of Ocracoke Island, N. C.

In order to make the results recorded in this paper conform with those obtained by Mr. Kearney, the nomenclature used is made identical with his. The nomenclature is mainly that followed in Britton and Brown's *Illustrated Flora of the Northern United States and Canada*, but, in order that those who are interested in ecological work and are not familiar with this nomenclature may find no difficulty in recognizing the species described, the names used in the later works of Gray and of Chapman are quoted in parentheses. It is hoped that by doing this—*i.e.*, adopting the same plan as used in the above-cited paper—an unbroken survey of the coast vegetation from Sandy Hook to North Carolina will be presented to the botanist ecologically inclined. In Mr. Herbert J. Webber's paper, "Dunes of Florida," printed in *Science*,[2] we have presented the conditions of plant growth as found along the seashore of Florida. What is needed to complete an account of the ecology of the Atlantic coast of temperate North America is a study of the strand vegetation of Long Island, which I believe to be much like that of New Jersey; a study of the New England coast, from Rhode Island to Maine, and a survey of the conditions to be found in Nova Scotia and Newfoundland, which work may well be committed to some enterprising Canadian botanist.

The appended list is derived from three sources of information:

[1] 1900, Kearney, "The Plant Covering of Ocracoke Island: A Study in the Ecology of the N. C. Strand Vegetation," *Contrib. U. S. Nat'l Herbarium*, Vol. V, No. 5, pp. 261–319.

[2] 1898, Webber, "Dunes of Florida," *Science*, N. S. Vol. VIII, pp. 651–660, 690–700.

(1) The collections of plants made by the writer at Seaside Park, South Atlantic City, Ocean City and Wildwood. (2) The specimens in the herbarium of the Philadelphia Botanical Club. (3) The "Catalogue of Plants Found in New Jersey," by Dr. N. L. Britton.[3] Synonyms are also given in the list, so as to render it more intelligible.

The several divisions under which the subject of the ecology of the New Jersey strand flora is presented are the following: (1) Physiography; (2) geology and soils; (3) climate; (4) the plant formations, their composition and physiognomy; (5) ecological forms—adaptations to environment; (6) phytogeography; (7) list.

PHYSIOGRAPHY.[4]

From Bay Head, lat. 40° 4′ N., to Cape May City, lat. 38° 58′ N., stretches in front of the mainland of New Jersey a protective barrier of sand, in width from a few rods to a half a mile, separated from the mainland by bays or shallow inlets of the ocean, or where these have been gradually filled in by the deposition of sand and the action of plants, by wide stretches of salt or tidal marshes, consisting of tide-swept sand, or covered by a luxuriant growth of salt-marsh plants. These narrow sand beaches which fringe the coast have been cast up by the action of the waves on the shallow continental ocean front. The sand thus deposited is caught up by the wind, which exerts a shovel-like action on the sand, greatest when an east wind blows, and is piled up in dunes, which on the New Jersey coast rise usually from

[3] *Final Report State Geologist of N. J.*, Vol. II, pp. 27–642.

[4] The student of the New Jersey coast flora is referred to the following excellent maps of the State and of the coast line:

"The Atlas of New Jersey," comprising maps showing Geodetic and Topographic Surveys of New Jersey, issued in 1889.

No. 9. Monmouth Shore, Sandy Hook to Manasquan.

No. 13. Vicinity of Barnegat Bay.

No. 16. Egg Harbor and Vicinity, including Atlantic shore from Barnegat to Great Egg Harbor.

No. 17. Cape May Shore Line.

No. 18. New Jersey State Map. Geographic.

No. 19. New Jersey Relief Map. Hypsometric.

No. 20. New Jersey Geological Map.

Coast Charts U. S. Hydrographic Office.

Chart 8. Montauk Point to Cape Henlopen.

Chart 121. Sandy Hook to Barnegat.

Chart 122. Barnegat to Absecon.

Chart 123. Absecon to Cape May.

15 to 25 feet, but on Seven-mile Beach to a height of 43 feet. In front of the dune formation extends the tidal beach proper of varying extent. It may be divided into the lower, the middle and the upper beaches, using the terms of Cowles.[5] At high tide the water never completely reaches to the base of the dunes, but with exceptionally high water or during a storm the base and even the top of the dune may be water-swept. Back of the primary dune formation are usually found other dunes more or less broken up into rounded eminences by wind action, and presenting deep gullies subject at all times to the scooping power of the breezes which are active in the formation of the dune complex.[6]

The upper beach exists at the places visited, according to the observations of the writer, only at Wildwood. Its limits elsewhere are vague and uncertain. The lower beach is the zone of land limited by the wash of summer storms, and is in New Jersey entirely barren of plant life. The middle beach is determined by the presence of driftwood and extends to the foot of the dunes. The hollows of the secondary dunes in depth usually correspond to the level of the ground water, for digging a few inches into the wet sand reveals the presence of fresh water, which has filtered through the sand from the ocean on the one side, and from the salt marshes or bays on the other. The force with which this sand is blown against obstacles in its path may be realized if one stoops down and faces it. The carving of dead and living trees exposed to these sand blasts is another evidence of their power.

Back of the dune complex, which is constantly shifting its position on the broader beaches, is found the belt or zone which has been captured by vegetation. Such belts are found at Seaside Park (a mile below the town at Read's Hotel), at South Atlantic City, where it exists in the middle of the salt marsh, at Ocean City and at Wildwood. I have denominated such areas thicket formations, in contradistinction to beach and dune formations. At Seaside Park proper, where the thicket formation does not exist,

[5] 1899, Cowles, "Dune Floras of Lake Michigan," *Botanical Gazette*, XXVII, p. 114.

[6] The dune complex consists of active or wandering dunes and of primary and secondary embryonic dunes, or those just starting to form by the piling up of the blowing sand around some obstacle. The most striking topographical effect of the dune complex is that of a vast, billowy sea of sand. It illustrates almost all conditions of a dune's life history.

the dune complex gradually slopes to meet the salt marsh which fringes Barnegat Bay, and is in turn followed by the sandy bay beach, which is backed by low dunes or sand hills a foot or two high. Where the thicket formation exists it may reach the bay dunes proper, when the salt marsh is practically absent, or exists as swampy depressions surrounded by shrubby or arborescent vegetation in the centre or edges of the thicket formation proper, as exemplified at Island Beach Life Saving Station, Seaside Park. Allusion will be made to these later, when the plants of the several formations are referred to. The position of these swampy areas, in which grow many salt-marsh plants, seems to indicate that at some time the sand has blown out upon the salt marsh, covering it up with dunes, afterward captured by woody plants which prevent them from wandering farther. At Wildwood and Ocean City the thicket formation is succeeded toward the westward by the low-lying, typical salt marshes.

The slope and position of these New Jersey beaches are constantly changing. At New Inlet, Long Beach extended three miles farther southward in 1885 than it did in 1841, while the beach south of Little Egg Harbor Inlet had grown one mile northward in the same time. Five-mile Beach had its south end three-quarters of a mile farther south and half a mile more to seaward than its position in 1772.[7] From Bay Head to Cape May, the beaches are cut through by ten inlets, through which the tide ebbs and flows to the bays inside. The interval between these inlets is over 20 miles at the north, but decreases to 2 miles near Cape May. There has been a tendency to decrease in the number of inlets and at least six have been permanently closed during this century. Inside of this line of beaches is a series of bays and sounds connected by a network of narrow crooked channels, called thoroughfares, in such a way that boats of light draft can pass from the head of Barnegat Bay over 90 miles down to Cape May, keeping entirely inside the beaches. Barnegat Bay is the largest of these, being nearly 30 miles long, with an area of 72 square miles. Its depth northward from Barnegat Inlet scarcely exceeds 10 feet, but southward it reaches a depth of 20 feet. It varies from two to four miles in width, leaving the beaches well cut off

[7] 1888, Vermeule, *Final Report Geological Survey of New Jersey*, I, p. 179.

from the mainland. Barnegat Beach, as the series of beaches to the eastward of Barnegat Bay are called collectively, may be taken, therefore, as the most typical beach of the New Jersey coast, and the one most exhaustively described from an ecological standpoint in this paper.

The salt marshes northward from Barnegat Inlet nowhere exceed a mile in width and are usually much less, as at Seaside Park. Southward they widen, encroaching more on the bays, but there is back of Long Beach a width of from two to four miles of water. Between Tuckerton and Beach Haven, Little Egg Harbor Bay is four miles wide. It has a depth of from 5 to 10 feet at mean tide, but there is a channel running down from Cedar Bonnets to the Inlet in which the minimum depth is 10 feet and the maximum 32 feet. Through this bay are scattered many islands of marsh, and at its foot a long tongue of marsh puts out from the mainland toward the south end of Long Beach, $4\frac{1}{2}$ miles. It is from 1 to 2 miles wide, and is cut up into numerous islands by thoroughfares. Going from Great Bay southward to Great Egg Harbor Bay, the tidal plain diminishes in width from $6\frac{1}{2}$ miles to less than three. It is fronted by Island, Brigantine and Absecon Beaches, back of which the marshes are cut up by a series of small bays and broad channels into countless islands, the areas of marsh and water being nearly equal. Southward in Cape May County the plain varies from 2 to 4 miles, and the marshes exceed in area the water.[8]

Geology and Soils.

From a geological standpoint, the sea beaches of New Jersey are of recent origin. They lie upon the older rock formations which crop out in parallel series along the Delaware river side of the State. Thes earlier rocky strata slant downward and southeastward, and presumably the whole of the overlying strata in southern New Jersey are built upon gneiss, which is followed in

[8] Under the caption "Plant Formations, their Composition and Physiognomy," more detailed reference will be made to the physiographical features of the places visited. The above account must suffice at this point. The student of the dynamics of dunes who desires to study the detailed effects of the wind action on the formation of dunes and the modification of vegetable organisms is referred to the papers of Dr. Cowles, where in an elegant style his studies on the dunes of Michigan are set forth at some length.

order upward by deposits of Cretaceous, Eocene, Miocene and Recent Periods. Numerous borings for artesian wells along the Atlantic seaboard have revealed the extent of the deposits of the several periods. These investigations have been pursued indefatigably by Woolman, who has given in several papers the results of his study.[9] The superficial deposits concern the ecologist, but the following data are given by way of comparing the superficial, recent soil deposits and the older, deeper-lying ones.

Artesian Well at Longport (803 feet deep).

Recent,	75 feet.	
Pleistocene,	93 "	
Age?	92 "	
Miocene,	543 "	Diatomaceous.
	803	

Diatomaceous bed extends from 292 to 664 feet = 372 feet thick.

Artesian Well at Wildwood (655 feet deep).

Recent { Soil and black muck full of roots of cedar and holly = 3 feet.
Beach sands, lower ten feet slightly darker in shade = 3 to 30 feet.

30–61 feet. Age?
61–152 feet. Marine and fresh-water diatoms.
61–290 feet. Age? Made up of mixed marine and fresh-water deposits, say 61 to 185 feet.
290–665 feet = Miocene.[10]

The details given as to the most superficial deposits, which form the soil in which plants grow, are instructive. At Seaside Park the vegetable mold is of but slight depth and barely covers the sand in the thicket formation. On the salt marsh it is about a foot deep. The dunes are practically without any vegetable detritus.[11] At Wildwood, which, as will be shown later, possesses

[9] Woolman, *Annual Reports New Jersey Geologist.*

[10] 1894, Woolman, "Vertical Sections of Wells at Atlantic City and Wildwood," *Annual Report New Jersey Geologist*, p. 188.

[11] The oxidation or removal of decaying vegetation is almost complete on the newer dunes, so that the accumulation of humus is not important. On the old, established dunes the mold becomes deeper and deeper, and after the lapse of centuries the sandy soil beneath may become buried so deeply that a mesophytic flora is able to establish itself, as beautifully exemplified on Five-mile Beach.

a remarkable forest growth, the depth of the vegetable mold is about three feet, indicating that the surface of Five-mile Beach was one of the first to have been captured from the drifting action of the winds. The soil of the dunes is chiefly quartz sand, consisting of grains remarkably uniform in size, since the wind has made a selection, being unable to pick up gravel or large sand particles. The sand, as a whole, appears whitish, but in the hollows of the dune complex it is generally streaked with grains of black sand, largely hornblende and magnetite. Such a sandy soil has a marked effect upon vegetation, being extremely porous and almost devoid of cohesion between the grains. Plants growing upon such porous sand deposits show always a xerophytic character. This is the character of the soil of most of the beaches of the New Jersey coast with the exception of Five-mile, Two-mile and Poverty, or Cape May Beaches, where the sand, being finer, is more compact and not easily blown into dunes. Wildwood, Holly Beach and Cape May have long been known for the silky or velvety character of their beach sands.

Another fact of very considerable interest must be mentioned here. Many beaches of to-day rest on the tide marsh and a very heavy storm will sometimes cut away the sand and expose the marsh on the ocean front. This was shown at Sea Isle City in 1892, but never to the knowledge of the writer at Barnegat Beach. The sand of the beach here, and in other places, has been carried over and deposited on the marsh, which was west of where the beaches formerly lay. This is shown at Island Beach Life Saving Station, where the old marsh has been entirely covered up with the exception of a few spots which exist as isolated marshy places in the midst of the dunes long since captured by trees and other plants. The drifting in of the beach and the wearing away of the sand in front has caused the kind of soil deposits described above.

Climatology.

The introductory remarks concerning the climate of the Atlantic coast of New Jersey are derived from the *Final Report of the Geological Survey of New Jersey*, Vol. I, "Topography, Magnetism, Climate," p. 347.

That part of the State which borders the ocean and is near enough

to be more directly exposed to the ameliorating influence of its waters is here designated as the Atlantic Coast Belt. The influence of the ocean's waters is felt very decidedly to a distance of four to eight miles from the line of beach, or outer coast line, from Sandy Hook to Cape May. The distribution of the open bays, tides, marshes, rivers and clearings alter this distance very considerably. In severe storms the salt spray is felt several miles back from the shore. "According to Eli Collins,[12] of Barnegat, a dry storm, September 3, 1821, carried spray of salt water three miles inland, upsetting stacks, etc. It lasted from 9 A.M. to 3 P.M. For two hours it was cloudy and dark as a hurricane. It killed the leaves of the trees, and after they fell new buds and flowers were developed the same year." Col. B. Aycrigg, of Passaic, says of the same storm: "Its violence may be estimated from the fact that where I was staying, two miles from the bay and six miles from the sea, the salt water was blown against the windows and left a crust of salt, which had the effect of ground glass, and the leaves on the southeast sides of the trees were killed, turned brown and dropped off." The effect of the prevailing sea winds is not, however, noticeable far from the shore in the pine districts. But the isolated and scattered trees of fields and the woods on the beaches all show it in their unsymmetrical growths.

Water equalizes the temperature and renders it more even. The winds from the sea are warmer in winter and cooler in summer. The sea breezes of the hot season spring up generally about noon, so that the maximum temperature of the day is in the forenoon, just before the inblowing of the cool sea air. The influence of these sea winds is to temper the extreme heat, to reduce both the range and the mean temperature in the warmer months, and to give a more humid character to the air.

The sea beaches situated, as they are in New Jersey, with the ocean on one side and the tidal waters on the other, have a climate partaking slightly of the insular type. Barnegat Station is separated from the mainland by four miles of water. There is a noteworthy difference in the winter season between Cape May and other coast stations. It is seen in the difference in the average daily minimum, which at Barnegat and Atlantic City is four to five degrees lower than it is at Cape May. The position of Cape May is more

[12] P. 348, *l.c.*

insular than that of Atlantic City or Barnegat. It is warmer in winter than Washington, and its mean daily range of temperature is four degrees less than Norfolk, Va. The range is nearly as low as Cape Lookout in North Carolina, and Key West, New Orleans and Galveston in the Gulf States. Figures show that in the daily range of temperature Cape May compares favorably with our most southern localities. The effect of so high a mean temperature in the spring is to produce crops of vegetables and small fruits quite as early as Portsmouth and Norfolk, Va., and the season is generally a month in advance of the same season in the northern part of the State.

The mild climate of Cape May appears in the character of its flora. Britton[13] says:

"(1) All the southern counties of New Jersey have a somewhat Southern flora, and it seems true that the further south we go the more pronounced does this become.

"(2) Although Cape May county has never been botanically explored to the extent that discoveries already made should warrant, yet it has already yielded a number of species of more southern distribution, and, so far as known, is the northern limit of the following six: *Œnothera humifusa* Nutt., *Diodia virginica* L., *Conoclinium cœlestinum* D.C., *Galium hispidulum* Michx., *Pluchea bifrons* D.C., *Paspalum walterianum* Schultes.

"(3) In addition to the above list, it may be stated that there are other species of a Southern character which probably occur in greater abundance in Cape May County than in any other part of New Jersey." *Pinus tæda* of the South has also been recently found near Cape May City.

Meteorological Record.

The data given in the accompanying tables represent the meteorological record of one year, that of 1898. The tables are compiled from the ninth annual report of the Board of Directors of the New Jersey Weather Service.

[13] Britton, *A Preliminary Catalogue of the Flora of New Jersey.*

Temperature, 1898.

The Sea Coast.	Elevation above Sea.	Length of Record, Years.	Annual Mean.	Departure from Normal.	Highest.	Date.	Lowest.	Date.
Barnegat.....	36	1						
Atlantic City...	53	16	53.1	+ 1.2	94	July 1	7	Feb. 2
Cape May.....	11	4	54.1	— 0.3	88	June 26 July 1	15	Jan. 30 Feb. 2

The record for Barnegat Lighthouse is not complete for the year, because no record was made for the months of January, February, June and July.

ANNUAL MONTHLY SUMMARY FOR THE THREE STATIONS GIVEN ABOVE.

Temperature.

Month.	Station.	Mean.	Maximum.	Date.	Min.	Date.	Mean of Max.	Mean of Min.	Mean Daily Range.
Jan.	Barnegat....								
	Atlantic City	36.0	60	13	12	2	42.3	29.6	12.7
	Cape May...	38.0	59	13	15	30	43.0	33.0	10.0
Feb.	Barnegat....								
	Atlantic City	34.6	59	10	7	2	41.4	27.8	13.6
	Cape May...	35.5	50	12	15	2	40.6	30.4	10.2
Mch.	Barnegat....	45.2	67	17	24	1	51.6	38.9	12.7
	Atlantic City	44.0	68	17	23	1	49.3	38.7	10 6
	Cape May...	44.8	64	20	26	1	48.9	40.6	8.3
Apr.	Barnegat....	48.1	74	17	25	6	55.9	40.3	15.5
	Atlantic City	46.9	77	17	24	6	53.7	40.1	13.6
	Cape May...	48.2	73	17	31	6	52.8	43.7	9.1
May	Barnegat....	54.2	84	20	41	9	60.6	47.8	12.8
	Atlantic City	55.5	76	20	42	9	60.7	50.3	10.4
	Cape May...	56.2	71	20	42	8	60.1	52.4	7.7
June	Barnegat....								
	Atlantic City	66.6	92	26	50	23	73.3	60.0	13.3
	Cape May...	67.8	88	26	55	6	72.4	63.1	9.3
July	Barnegat....								
	Atlantic City	73.2	94	1	58	12	77.9	68.6	9.3
	Cape May...	73.0	88	1	62	11	76.5	69.4	7.1
Aug.	Barnegat....	75.8	92	31	63	27	82.1	69 5	12.5
	Atlantic City	74.2	91	25	60	28	79.1	69.3	9.8
	Cape May...	74.4	83	2	65	28	77.3	71.4	5.9
Sept.	Barnegat....	70.8	94	3	53	21	78.3	63.2	15.1
	Atlantic City	68.0	89	3	50	21	74.3	61.7	12.6
	Cape May...	68.0	83	3	55	21	71.4	64.3	7.1
Oct.	Barnegat....	59.8	78	4, 5	37	28	66.6	52.9	13.7
	Atlantic City	57.5	75	3	35	28	63.9	52.1	11.8
	Cape May...	58.8	72	5, 6	35	28	62.5	55.0	7.5
Nov.	Barnegat....	45.5	66	4	24	27	52.9	38.1	14.8
	Atlantic City	44.1	62	2	24	28	50.5	37.7	12.8
	Cape May...	46.4	63	10	26	27	50.9	42.0	8.9
Dec.	Barnegat....	36.4	54	5, 31	20	9, 10	43.2	29.5	13.7
	Atlantic City	36.4	56	4	12	14	42.9	28.8	13.1
	Cape May...	37.8	50	31	21	14	42.4	33.2	9.2

The date of the last killing frost in spring for Barnegat City in 1898 was April 8; for Cape May City, April 7, and for Ocean City, April 8.

The first killing frost in autumn (1898) occurred at Barnegat City, Cape May City and at Ocean City on the same day, October 28. The length of the season in days at the several places was as follows:

Barnegat City, ... 203 days.
Ocean City, ... 203 "
Cape May City, ... 204 "

Precipitation, State of Weather, Wind, 1898.

Station.	Precipitation, in Inches.							State of Weather.				Wind.
	Total for Year.	Departure from Normal.	Greatest Monthly.	Month.	Least Monthly.	Month.	Total Snow-fall.	Number of Rainy Days	Number of Clear Days.	No. Partly Cloudy D'ys	Number of Cloudy D'ys	Prevailing Direction of Wind.
Barnegat.	.....	.....	5.94	Nov.	1.52	Sept.						
Atlantic C'y	38.68	—4.13	5.51	Nov.	1.81	Sept.		127	123	139	103	N. W
Cape May.	40.80	+7.68	4.81	Apr.	1.55	Feb.		133	145	96	124	N. W.

Month.	Station	Precipitation.				State of Weather.			Wind.
		Total Precipitation.	Greatest in 24 Hours.	Date.	Numb'r Days 0.01 or more.	Clear	Partly Cloudy.	Cloudy.	Prevailing Direction
Jan.	Barnegat....								
	Atlantic City	3.39	0.97	15, 16	13	6	13	12	N.W.
	Cape May...	3.06	0.86	15	13	9	10	12	N.W.
Feb.	Barnegat....								
	Atlantic City	1.86	1.40	19, 20	8	15	8	5	N.W.
	Cape May...	1.55	0.97	19	8	15	6	7	N.W.
Mch.	Barnegat....	3.54	0.90	4, 5	8	7	19	5	N.E.
	Atlantic City	2.56	0.70	29, 30	11	7	12	12	E.
	Cape May...	3.00	0.94	4	14	8	9	14	N.E.
Apr.	Barnegat....	3.64	1.33	28, 29	7	11	12	7	N.E.
	Atlantic City	2.67	0.75	28, 29	13	4	16	10	N.W.
	Cape May...	4.81	1.98	28	13	9	9	12	N.W.
May	Barnegat....	5.63	1.50	15	17	11	11	9	N.E.
	Atlantic City	5.17	1.22	12, 13	16	6	13	12	S.W.
	Cape May...	3.92	0.93	16	17	10	6	15	N.E.
June	Barnegat....								
	Atlantic City	2.49	1.59	28, 29	10	13	14	3	S. W.
	Cape May...	2.02	0.60	20	11	15	9	6	S. W.
July	Barnegat....								
	Atlantic City	2.23	1.18	12, 13	8	11	14	6	S.W.
	Cape May...	4.13	1.15	13	12	11	11	9	S.
Aug.	Barnegat....	2.70	1.30	10, 11	5	18	10	3	S.W.
	Atlantic City	3.99	1.93	10, 11	6	14	13	4	S.W.
	Cape May...	4.76	1.21	12	6	15	8	8	S.
Sept.	Barnegat....	1.52	1.10	22, 23	4	19	10	1	N.E.
	Atlantic City	1.81	1.14	23	8	19	4	7	S.W.
	Cape May...	3.25	1.24	26	7	18	6	6	S.
Oct.	Barnegat....	5.25	1.30	26, 27	10	17	10	4	N.E.
	Atlantic City	4.60	1.75	26	11	9	14	8	N.W.
	Cape May...	3.94	1.42	26	10	13	8	10	N.W.
Nov.	Barnegat....	5.94	1.30	29, 30	11	11	11	8	N.W.
	Atlantic City	5.51	1.25	26, 27	13	9	9	12	N.W.
	Cape May...	3.83	0.72	29	12	9	8	13	N.W.
Dec.	Barnegat....	3.54	1.52	19, 20	9	14	8	9	N.W.
	Atlantic City	2.40	0.79	19, 20	10	10	9	12	N.W.
	Cape May...	2.53	0.54	20	10	13	6	12	W.

THE PLANT FORMATIONS, THEIR COMPOSITION AND PHYSIOGNOMY.

The various areas which are definitively marked by the character of the vegetation pass in some cases insensibly into each other, so that they overlap or are dove-tailed like wedges, these physiographical features being brought about by the sort of topography which prevails in a given area. For example, a mile below the town of Seaside Park the dune complex, almost entirely bare of trees, stretches completely across the beach, which is here about half a mile wide. In making the ecological reconnoissance at the four points chosen for study—namely, Seaside Park on Barnegat Beach, South Atlantic City on Absecon Beach, Ocean City on Peck's Beach, and Wildwood on Five-mile Beach—the following belts or zones of the different formations may be given in outline, the exceptions to the typical disposition of the belts or zones being due to the physiographic changes brought about by the closure of inlets, the drifting of sand, and the wearing action of the waves on the beach front and their scouring action upon the tide marsh:

I. Sea-strand vegetation.
  1. Treeless open.
    A. Beach formation.
      (*a*) Succulent zone (middle beach).
        Cakile–Ammodenia society at Seaside Park, South Atlantic City and Ocean City.
        Salsola society at Ocean City and Wildwood.
        Atriplex society at Wildwood.
      (*b*) Œnothera humifusa zone (upper beach only at Wildwood).
    B. Dune formation.
      (*a*) Ammophila zone at Seaside Park, South Atlantic City, Ocean City and not clearly at Wildwood.
      (*b*) Myrica zone at Seaside Park, South Atlantic City, Ocean City.
      (*c*) Hudsonia zone, comprising the greater part of the dune complex, at Seaside Park only.
        Rhus radicans–Ampelopsis society at Seaside Park and Wildwood.
        Dune-marsh society at Seaside Park and Ocean City.

Baccharis–Rosa society, bordering the dune-marsh society and growing upon the captured slopes of the dunes of the dune complex (Hudsonia zone), at Seaside Park only.

2. Tree clad (trees and shrubs).

A. Thicket formation at Seaside Park, South Atlantic (on high dune in middle of salt marsh), Ocean City and most luxuriantly at Wildwood, comprising two zonal areas, the second surrounding the following associations (Kearney), or societies:

(*a*) Juniper zone.

(*b*) Zone of mixed vegetation.

Thicket marsh society at Seaside Park and Wildwood.

Hudsonia society at Seaside Park and Wildwood.

Scirpus society at Seaside Park.

Cat-tail society at Seaside Park.

Marsh Shield–fern society at Seaside Park and Wildwood.

Osmunda society at Wildwood.

Ptilimnium society at Wildwood.

Polygonum society at Wildwood.

B. Marsh-dune formation at Seaside Park and elsewhere on the coast, where isolated rounded hills of sand arise from the centre of the marsh and are covered with a variety of shrubs and occasionally one or two trees, evergreen or deciduous. At South Atlantic City such a dune island exists in the marsh, but its length and the complexity and size of the growth upon it compel us to classify it under 2. *A.* Thicket formation proper.

II. Salt-marsh vegetation.

A. Tidal-flat formation, covered at exceptionally high tides, along the entire coast.

B. Saline-marsh formation at South Atlantic City and Wildwood and many other places back of the beaches.

C. Converted saline-marsh formation (fresh), redeemed from the effect of the tidal brackish waters of the

bays by the formation of a sandy beach and a low dune along its bay side. This sandy beach and dune completely closes off the marsh from salt water, except where the so-called slues are found which permit the ingress and egress of the tidal water to limited areas of the marsh. Such areas of the marsh, therefore, are covered with vegetation more truly adaptive in character. Such a marsh is found at Seaside Park about 700 feet wide, and from the drier portions of it salt hay is cut periodically.

III. Bay-strand vegetation (absent where the saline-marsh formation exists).

A. Dune formation as at Seaside Park, where the dune supports a variety of plants. This formation one mile below Seaside Park merges itself insensibly with the thicket formation proper. In fact, no line of demarcation between these two formations can be drawn at that point.

B. Bay-beach formation at the limit of high tide, covered with the dead and dried leaves of eel-grass, *Vallisneria spiralis* washed up by the waves.

IV. Bay-water vegetation.

(*a*) The Plankton (not investigated).

(*b*) Ruppia zone in the shallow waters along the eastern shore of the bays (investigated at Seaside Park).

(*c*) Nereid zone, comprising the algæ which grow on the pilings sunk into the sand for landings and as jetties to prevent wave action. These algæ exist in considerable abundance, especially near the inlets and open bays communicating with them, where the salt water of the ocean has full effect. This zone was not investigated. A number of other zones and societies might be delimited, but the above indicate that a careful study of them would amply repay the ecologist.

I. Sea-Strand Vegetation.

1. Treeless, Open Formations.

A. Beach Formation.

The beach formation exists at the several places investigated in several modifications of the typical one, which exists at Seaside Park, N. J. The lower beach is limited by the reach of the higher tides and is marked by the constant shifting and grinding of the particles of sand against each other by wave action. No plants can exist under such trying conditions—the pounding action of the waves, the grinding of the beach sand, the desiccating effects of the sun and wind when the beach is exposed at low tide. The middle beach, where driftwood collects, supports a considerable number of herbaceous annuals, which show in a striking way their adaptation to unpropitious surroundings. They possess in the extreme a xerophytic character of succulence, and this permits them to exist in a porous soil of drifting sand and within the influence of the salt spray.[14] The most abundant plant of the middle beach in all the localities studied is *Cakile edentula* (Bigel.) Hook., the sea blite, with long branching tap-root and jointed, indehiscent, fleshy fruit of two compartments. The leaves of this plant are thick and succulent and thus well adapted to the extreme xerophilous conditions to which beach plants are subjected. Associated with this succulent is also another, *Ammodenia peploides* (L.) Rupr., which grows in clumps, and is of a dark-green color with thick, fleshy leaves. It forms the so-called annual dunes which are piled up around its succulent stems, remaining as small hillocks of sand, through which this plant protrudes, until autumn, when upon the death of the sand-binder the sand is again caught up by the wind and carried away. *Cakile edentula* (Bigel) Hook. is also instrumental in catching the sand and holding it in the form of embryonic dunes. These two plants are the only ones found commonly on Barnegat Beach at Seaside Park.

At South Atlantic City, in addition to *Cakile* and *Ammodenia*, which are also found there, grow *Salsola kali* L., *Euphorbia polygonifolia* L. and *Cenchrus tribuloides* L. *Salsola kali* L. is ex-

[14] For physiological details the reader is referred to Kearney's "The Plant Covering of Ocracoke Island," *Contrib. U. S. National Herbarium*, Vol. V, p. 275, 1900.

tremely xerophytic with succulent stem and leaves and spinous habit. *Euphorbia polygonifolia* L., a prostrate herb, possesses latex, which is probably instrumental in reducing transpiration. *Cenchrus tribuloides* L., of annual habit, depends upon its prickly fruit for its distribution and very existence. It is abundant, as a character plant, at South Atlantic City, along the dune faces in the zone of succulents, and also as a component of the flora in the zones more distantly removed from the ocean front. This is true of this grass both at Ocean City and Wildwood, where it is not conspicuous by its presence on the middle beach.

The most interesting distribution of plants is met at Wildwood. Here the beach is extremely flat and very wide, trending to the northeast, where apparently it is widest. The lower beach consists of sand, packing well together, and when wet presenting a hard, firm, floor-like surface. Just above the ordinary limit of high tide are little hummocks of sand held in place by the stalks of grasses and other herbaceous plants which have been washed up by tidal action. This area of loose sand is succeeded by a line of more elevated sand bordering a tidal depression inside it. Upon this low ridge of sand *Salsola kali* L. grows in the greatest abundance, and an inspection indicates that the tide must flow at times between the *Salsola* patches. On the far side of the tidal pool are found, in association with isolated clumps of the marram grass, *Ammophila arenaria* (L.) Link., growths of an annual *Atriplex arenaria* Nutt., a chenopodiaceous plant with reddish-colored bushy-branched stem and fleshy leaves. Proceeding up the beach in a straight line, a wind-swept area tenanted by marram grass and isolated plants of *Xanthium Canadense* Mill. var. *echinatum* (Murr.) Gray, *Euphorbia polygonifolia* L., *Salsola kali* L. (not as a character plant), *Sesuvium maritimum* (Walt.) B. S. P., and *Strophostyles helvola* (L.) Britt., just in flower, trailing as a prostrate vine over the sandy soil, are passed. The only area which merits the name Ammophila zone occupies the portion of the beach adjoining that just described, but the sand grass, *Ammophila arenaria* (L.) Link., although abundant here, hardly can be called a zonal plant at present, although it has commenced to build a frontal dune, which when raised above the level of the beach (a stage which it has not yet reached) may separate the middle beach from the upper beach sufficiently to merit the application of the zonal name to this area of the Wildwood sea-strand. The sand

grass growing here was found in full flower associated with *Ammodenia peploides* (L.) Rupr., gathering the sand about it, and *Strophostyles helvola* (L.) Britt., creeping out as a radiant plant in all directions. As an introduced stray, the tomato plant, *Lycopersicon Lycopersicon* (L.) Karst., was picked up in this area, much depauperate and beaten by the blasts of sand and wind and hardly recognizable except by its odor and the lobed leaves with smaller lobes interspersed in the sinuses.

The Œnothera humifusa zone, or upper beach, comprises the hollow place in front of the low frontal dune and the seaward face of the dune itself. Here grow in perfect harmony *Gerardia purpurea* (L.), *Strophostyles helvola* (L.) Britt. with narrower leaflets, *Solidago sempervirens* L. with thick leaves, which is found on the lee face of the sea dunes farther northward, *Leptilon canadensis* (L.) Britton and *Œnothera humifusa* Nutt.—the plant which gives name to this interesting assemblage of species. The latter is chosen as a character plant, because Cape May county represents the northern limit of its distribution, which extends to Florida. *Œnothera humifusa* Nutt. is essentially southern in its range, occurring on the sea beaches of the Southern States. Its presence is proof of the mild climate of Wildwood, which has already been referred to. The lower face of the dune here supports *Lactuca canadensis* L. and life-everlasting, *Anaphalis margaritacea* (L.) Benth. and Hook.

B. Dune Formation.

(*a*) Ammophila Zone.—Upon the top and lee side of the sea dune at Seaside Park, which extends in some places uninterruptedly there for a distance of half a mile, with a uniform height of about 15 feet, and at a uniform distance from the ocean front, grows the best of all sand-binders, *Ammophila arenaria* (L.) Link. A perennial dune such as at Seaside Park requires perennial dune-formers, which must be also plants which possess the power of growing out into the light when buried in the sand, and of spreading radially by rootstock propagation. These requirements of a successful dune-former and holder marram grass possesses in the highest degree. Cowles[15] gives an exhaustive account of how this grass accomplishes this object so perfectly. Associated

[15] 1899, Cowles, "Dune Floras of Lake Michigan," *Botanical Gazette*, p. 180.

in a remarkable ecological way with this grass is the sand pea, *Lathyrus maritimus* (L.) Bigel., which flourishes with it on the dune summit. It has long been known that with the numerous tubercles on their roots which store up nitrogen, leguminous plants can thrive apace in almost pure sand. The beach pea does this on these porous dunes and not only lives for itself, but upon its death enriches the sandy soil with nitrogenous compounds. The clumps of sand grass growing in immediate proximity to the leguminous perennial herb seizes hold of the nitrogenous products with avidity and becomes correspondingly thrifty, denser in growth and of a darker green color than the same grass in the neighborhood, growing outside of the benign influence of *Lathyrus maritimus* (L.) Bigel. That the beach pea is not in danger of extinction, but has a firm hold upon the dune, will be shown by a close inspection of the following statistics giving the result of the pollination of the flowers. Ten plants were chosen and a careful enumeration was made of the fruits and seeds produced.

Fruit and Seed Production Lathyrus maritimus (L.) Bigel.

a = abortive seeds; p = pierced; e = eaten; A, B, etc. = fruit clusters.

Plant.	Numb'r of Fruit Clust's.	Number of Pods in the Clusters.	Number of Seeds in Each Pod.	Total No. of Good Seeds.
I	1	1	1	1
II	2	A 1, B 2	A 1 = 0; B 1 = 4, B 2 = 3	7
III	2	A 1, B 2	A = 2; B = 0	2
IV	3	A 1, B 2, C 4	{A = 0; B 1 = 3, B 2 = 2 + 1a; C 1 = 1, C 2 = 2, C 3 = 0}	8
V	4	A 1, B 2, C 2, D 2	{A = 5; B 1 = 2, B 2 = 4; C 1 = 0, C 2 = 7; D 1 = 2, D 2 = 2}	22
VI	1	A 4	A 1 = 1, A 2 = 2, A 3 = 2 + 1a, A 4 = 4a	5
VII	1	A 5	A 1 = 1a, A 2 = 2 + 2a, A 3 = 0, A 4 = 0, A 5 = 0	2
VIII	3	A 6, B 3, C 3	{A 1 = 1, A 2 = 2, A 3 = 1, A 4 = 2 + 1a, A 5 = 2; A 6 = 2p; B 1 = 5, B 2 = 2, B 3 = 5; C 1 = 1, C2 = 2 + 3a, C 3 = 0}	22
IX	3	A 4, B 5, C 5	{A 1 = 4, A 2 = 1, A 3 = 2 + 1a, A 4 = 3; B 1 = 2, B 2 = 2 + 2a, B 3 = e, B 4 = 3 + 2e, B 5 = 1}	18
X	3	A 3, B 1, C 5	{A 1 = 2, A 2 = 2, A 3 = 2; B = 1a; C 1 = 2a, C 2 = 2, C 3 = 1, C 4 = 3, C 5 = 5}	17

At South Atlantic City the frontal dune is very much broken

up into many summits, upon which and the lee side *Ammophila arenaria* (L.) Link. grows as the principal character plant. This is also true of the lower dunes at Ocean City, which are nowhere so bold or prominent as at South Atlantic City. The Ammophila zone at Wildwood, as previously stated, is doubtfully referred to as an area between the middle and upper beaches and constituting in reality the inner part of the middle beach. It seems apparent that a dune is just beginning to form at that point of the beach, and will grow much more rapidly as the timber is removed by the march of so-called improvements which threaten the beauty of Wildwood Beach.

(*b*) Myrica Zone.—Just behind the high dune which faces the ocean and on its lee slope, protected by the top of the dune, is met an extensive belt of *Myrica cerifera* L., which occurs normally at Seaside Park, South Atlantic City and Ocean City, but is absent at Wildwood. It occurs typically at Seaside Park and also clearly defined at South Atlantic City, but at Ocean City it is broken up into two parallel areas behind the second and third series of dunes. Normally it should occur behind the first or frontal dune. Isolated specimens of *Myrica cerifera* L. are found in the thicket formation, but as far as inspection showed it does not grow as a zonal plant. Associated with the waxberry bushes at Seaside Park is the ubiquitous sand grass (*Ammophila*), an occasional golden-rod (*Solidago sempervirens* L.) and a prostrate growth of *Euphorbia polygonifolia* L., but that is all. At Ocean City *Strophostyles helvola* (L.) Britton, *Panicum virgatum* L., *Baccharis halimifolia* L., *Rhus radicans* L. are mixed together by reason of the parallelism of the three dunes which occur there, and *Myrica*, therefore, becomes an element of the dune complex. In becoming an element in the dune complex (Hudsonia zone), *Myrica cerifera* L. has also become a component of the Rhus radicans–Ampelopsis society of the classification, and consequently it surrounds typical marsh plants, such as *Kosteletskya virginica* (L.) A. Gray, *Hibiscus moscheutos* L., *Sabbatia stellaris* Pursh., *Ptilimnium capillaceum* (Michx.) Hollick, *Scirpus debilis* Pursh., and the like, composing the dune-marsh society.[16]

(*c*) Hudsonia Zone—the Dune Complex.—This zone is of espe-

[16] This mixing of the several societies by the intrusion of the Waxberry is further proof of the difficulty of a strict classification.

cial interest. The topography is kaleidoscopic. The dunes are constantly changing their shape, being blown away on one side and built up on the other. The hollows between them are filled up and new valleys are scooped out by the resistless action of the wind. This is true of this belt along the entire New Jersey coast, where it is a dominant feature of the landscape, but the change is not so rapid in some places as in others. Some of the dune complexes change very slowly, others more rapidly; some, it may be, have become stationary. While there is a general advance of the complex as a whole in the direction of the prevailing winds, individual portions are advancing in all directions in which winds ever blow. All stages in the life-history of a dune may be seen—the beginning, the climax, the destruction. Here and there great hollows are formed, which reach down almost to the water level. Here and there vegetation has obtained a foothold on the complex, thus capturing such portions and forming them into established dunes. The most striking feature of the dune complex, then, is its topographic diversity. At Seaside Park, the dune complex extends from the limits of the Myrica zone already defined to the Juniper zone of the typical thicket formation. In it are found troughs running at all angles with the main troughs in the direction of the influential winds. The dune complex exists in all the places visited, but its vegetable covering is different. At South Atlantic City it does not exist; at Ocean City it is an area of established dunes clothed with a variety of plants; at Wildwood it is a narrow area of a low frontal dune and a hollow immediately behind it, encroached upon by tree growth, and is, therefore, not clearly demarcated at either of the places last mentioned.

At Seaside Park, where it typically exists, there is not an established series of dunes, but the change is a slow one, motion being arrested by the character plant, *Hudsonia tomentosa* Nutt., which forms clumps or cespitose clusters closely set together on the top and sometimes the slopes of the slowly moving dunes. This plant, which is so characteristic and definitive zonally speaking, is densely tufted, intricately branched, matted and hoary-pubescent with densely imbricated and appressed leaves. Each clump is separated from its neighbor by a narrow channel of sand, so that to the eye the belt has a hummocky appearance, such as to give it a desert aspect, as so well illustrated in Schimper's *Pflanzen-*

geographie auf Physiologischer Grundlage, fig. 359, opposite p. 658; fig. 375, p. 671. The common names, beach heather and poverty grass, are well chosen, and give expression, on the one hand, to the appearance of the plant itself, and, on the other, to its growth as influenced by surrounding conditions. Associated with this low-growing perennial herb are found *Solidago sempervirens* L., *Rhus radicans* L., trailing over the ground and with an etiolated appearance, expressive of its struggle for supremacy, *Linum medium* (Planch.) Britton, *Lechea maritima* Leggett and others, such as *Ampelopsis quinquefolia* Michx., which is an occasional intruder on the more established dunes.[17] However, along the geologic shore line of an old inlet which was gradually filled in and converted into marsh, a line of dunes stretches from the ocean to the bay front, forming a dune complex at right angles to the main one, which at Seaside Park runs parallel to the seashore. This dune complex is nearly stationary; even more so than the main complex, because lying to the north of the thicket formation, which it bounds in that direction; and the dunes are covered with beach heather to an extent which makes it the dominant plant of the transverse dune complex.[18] Upon this transversely placed Hudsonia belt exist isolated trees of the following species in considerable numbers, but nowhere growing together, except it may be in companies of twos or threes, usually, however, standing alone: *Quercus ilicifolia* Wang. (*Q. nana* (Marsh.) Sarg.) is a small tree of dense growth; *Ilex opaca* Ait. is strong-growing and dark green in color; *Quercus phellos* L., the willow oak, forms a dwarf tree about four feet high; *Vaccinium corymbosum* L., with smooth leaves, and *Vaccinium atrococcum* (A. Gray) Heller, with densely pubescent leaves and gnarled form, both loaded with berries, were found to exist here, with *Kalmia angustifolia* L., in fruit, and *Rubus canadensis* L. trailing at their base. *Pinus rigida* Mill. also is a component element of the transverse dune complex, growing with the sassafras on the dune slopes and drier

[17] *Prunus maritima* L., the beach plum, forms by its upward growth small dunes, comparatively steep. It usually grows in isolated patches on the slopes or summits of the dunes, near the centre or inside margin of the dune complex.

[18] In the subsequent descriptions of this transverse dune complex the geologic beach of the old inlet will be spoken of in these terms as it exists one mile below the town of Seaside Park.

dune hollows. *Juniperus virginiana* L. is also abundant here. The landscape has, therefore, somewhat of a park-like aspect.

The dune complex (not Hudsonia zone) at Ocean City is a succession of dunes and dune hollows. Upon the top of the dunes and covering their slopes to some extent the marram grass, *Ammophila,* has almost full sway, but occasionally *Sieglingia purpurea* (Walt.) Kuntze, *Strophostyles helvola* (L.) Britton and *Solidago sempervirens* L. are associated with the above-mentioned grass. In the hollows are found *Scirpus debilis* Pursh., *Strophostyles helvola* (L.) Britton, *Panicum virgatum* L., *Cyperus Nuttallii* Eddy, *Gerardia purpurea* L., with *Myrica cerifera* L. and *Baccharis halimifolia* L. growing upon the slopes of the sand hills and the drier depressions of the dune complex. The dune complex at Wildwood is a narrow belt (50 feet wide) of established dunes. It might be said to belong to the thicket formation, but for the fact that it is open. Upon the low dune, 4 or 5 feet high, flourish *Rosa carolina* L., *Rhus radicans* L., *Sieglingia purpurea* (Walt.) Kuntze, *Phytolacca decandra* L., and dead, badly wind-swept cedar trees. Immediately behind the dune front *Ampelopsis quinquefolia* Michx., *Panicum virgatum* L., *Andropogon virginicus* L., in clumps, and *Monarda punctata* L. make up the list of conspicuous plants of the narrow dune complex of Wildwood Beach. Several isolated trees, *Juniperus virginiana* L., *Quercus minor* (Marsh.) Sargent, of dwarf growth stand here, and form the vanguard of the tree growth which so completely covers the higher portion of Five-mile Beach.

The dune-marsh society is typically developed at Seaside Park, and to a less extent at Ocean City. The plants which form it inhabit the depressions of the dunes, which reach to water level. The species, therefore, associated together as a happy family are essentially of a marsh habit. The dune marshes at Seaside Park are somewhat different in character in different localities and under varying surroundings. In one such marsh situated near the Island Beach Life Saving Station grow *Ptilimnium capillaceum* (Michx.) Hollick, *Polygonum hydropiperoides* Michx., *Hypericum mutilum* L., *Scirpus debilis* Pursh., *Carduus spinossissimus* Walt., *Gyrostachys cernua* (L.) Kuntze, *Teucrium canadense* L., while as a bordering growth on the dune slopes of the marshy depressions occurs the Baccharis-Rosa society of our classification. Ecologi-

cally the Baccharis-Rosa society comprises three dominant species: *Rosa carolina* L., *Baccharis halimifolia* L., *Rhus copallina* L.

The marshy hollows of the transverse dune complex at Seaside Park resemble, physiognomically, a typical pine barren swamp in its constituent elements. Such a one, explored, yielded *Juncus effusus* L., *Panicum amarum* Ell., *Drosera filiformis* Raf., the cranberry, *Oxycoccus macrocarpus* (Ait.), Pers., as the character plants of such situations, while near by, as already mentioned, grow other pine-barren forms such as *Sassafras Sassafras* (L.) Karst., *Quercus nana* (Marsh.) Sarg., *Quercus phellos* L., *Vaccinium corymbosum* L., *Vaccinium atrococcum* (A. Gray) Heller, *Kalmia augustifolia* L., and *Pinus rigida* L. The character of the dune-marsh growth of the dune complex at Ocean City has already been described, and it is therefore not necessary to consider it further in detail.

2. TREE-CLAD STRAND.

A. Thicket Formation.

The thicket formation developed typically at Seaside Park and Ocean City reaches its greatest proportions at Wildwood. At South Atlantic City it covers a long, high dune, which is situated, as an island, in the middle of the salt marsh which everywhere surrounds it. It will, therefore, be described in sequence with the others, although it is misplaced, zonally speaking.

One mile below the town of Seaside Park the beach thicket covers a considerable area, many acres in extent and quite impenetrable in some places. It is fronted by a belt or zone of juniper trees, which are wind-tossed and gnarled by their long struggle with the elements.

(*a*) Juniper Zone.—The vanguard consists of cedars, which never rise above the dunes of the dune complex upon which they grow. Young trees in the dune hollows are spire-shaped, but upon reaching the general level of the dune summit they become flat-topped, incline in the direction opposite to the prevailing wind, and become gnarled and weather-beaten. The cedars of the zone proper form an almost pure growth in front of the main thicket, grow much larger and seem to be more independent of their surroundings. Several well-marked varieties of this tree are met

with. The young trees have sharp, aculeate leaves, widely divergent and loosely set on the twigs. In color they are either dark green or yellowish green; the dark green specimens have longer leaves than the light green ones, the twigs of which are more elongated and widely spreading. Spire-shaped trees of the vanguard have a close growth, the leaves are closely appressed and overlapping, and are obtuse. The young twigs are essentially similar in appearance, but more elongated. Another spire-shaped tree of the same size and from the same locality showed leaves of the closely appressed type on the older twigs, but more acuminate, while on the younger twigs the primary leaves were large acuminate, as were also the smaller appressed leaves of the same region. This tree had a bluish green cast of foliage. The wind-swept trees show the struggle they wage, not only in their gnarled, inclined and flat-topped growth, but also in the closeness of the twigs, the appressed condition of the leaves, which are small, short and blunt. The younger twigs are also extremely abbreviated, as if the tree had to conserve all of its energies for the apparently unequal struggle. The Juniper zone, clearly defined, is not met with at South Atlantic City, Ocean City or Wildwood, and is apparently absent from those places.

(*b*) Zone of Mixed Vegetation.—This at one mile below the town of Seaside Park is a veritable jungle, composed of trees, shrubs and lianes, broken there by dry or swampy open glades. The thicket is impenetrable in a number of places owing to the thick growth, and to *Smilax rotundifolia* L., covered with spines, and *Ampelopsis quinquefolia* Michx., which grow as climbing vines, looping themselves from limb to limb and from tree to tree. The most notable species entering into the formation are *Juniperus virginiana* L., *Ilex opaca* Ait., *Iva frutescens* L. along the margins, *Quercus nana* (Marsh.) Sarg., *Rosa carolina* L., *Pinus rigida* Mill., *Rhus copallina* L., and the climbing form of *Rhus radicans* L. It is worthy of note that here the holly trees are larger, more open and provided with larger leaves than the trees of the exposed, wind-swept transverse dune complex.

The thicket at South Atlantic City covers the high insular dune and the hollows and minor dunes behind it. The crest of the dune is probably 30 or 35 feet above the level of the salt marsh, and the hollow behind it is correspondingly depressed. *Pinus*

rigida Mill., *Quercus minor* (Marsh.) Sarg., *Cassia chamæcrista* L., *Vitis æstivalis* Michx., *Viburnum dentatum* L., *Juniperus virginiana* L. of three varieties are found, with *Monarda punctata* L. on the front face and summit of the dune, while in the valley behind grow *Quercus digitata* (Marsh.) Sudw., *Ilex opaca* Ait., one form with spiny margined leaves of the usual type and another with spineless entire leaves, revolute margins, smaller in size and ovate acuminate, *Pinus rigida* Mill., densely filled with old cones, *Sassafras Sassafras* (L.) Karst., and persimmon, *Diospyros virginiana* L. These trees reach a large size, but when they reach the height of the dune summit become flat-topped and wind-swept. The ground of the valley is open, almost entirely destitute of smaller growth, except the smaller trees of the species just mentioned, and the bracken, *Pteris aquilina* L. The thicket at Ocean City is formed of *Prunus maritima* L., which occupies the front of it, *Ilex opaca* Ait., *Juniperus virginiana* L., *Quercus nana* (Marsh.) Sarg., *Rhus copallina* L., *Smilax rotundifolia* L., *Ampelopsis quinquefolia* Michx., and *Vitis æstivalis* Michx., growing upon the open sandy places in front, and among the trees a number of herbaceous plants flourish, such as *Monarda punctata* L., *Cenchrus tribuloides* L., etc.

Wildwood forest, using a dignified term for a remarkable growth of trees and shrubs, is part of the thicket formation on Five-mile Beach, constituted by the association of the following arborescent species: *Juniperus virginiana* L., *Prunus maritima* Wang., *Quercus minor* (Marsh.) Sarg., *Quercus alba* L. x *Q. minor* (Marsh.) Sarg., *Myrica cerifera* L., *Sassafras Sassafras* (L.) Karst., *Nyssa sylvatica* Marsh., *Magnolia virginiana* L., *Acer rubrum* L., *Prunus serotina* Ehrh., *Quercus digitata* (Marsh.) Sudw., and *Vitis Labrusca* L. The vine which grows here reaches a foot in diameter, and is a true liane. Upon the ground, usually in the sandy open places, abound *Cassia chamæcrista* L., *Strophostyles helvola* (L.) Britton, *Solidago odora* Ait., *Solidago fistulosa* Mill., *Panicum amarum* Ell., *Eupatorium hyssopifolium* L., *Willughbœa* (*Mikania*) *scandens* (L.) Kuntze, *Lespedeza capitata* Michx., *Lycopus sinuatus* Ell., *Lippia lanceolata* Michx., *Ambrosia artemisiæfolia* L., near the railroad, *Helianthus giganteus* L., *Meibomia paniculata* (L.) Kuntze, along the railroad, with many other species, most native, some introduced.

There are many peculiar growths in this forest area, due, it seems, to a combination of causes. Vigor and density of growth are due to a mild, moist climate and a soft, moist soil, which Wildwood is known to possess. Strong winds and the work of cattle, no doubt, in part account for the close, jagged growths which are common there. Cattle for many years ran wild on this island, which two hundred and thirty-six years ago Charles II of England granted to his brother James, Duke of York, March 12, 1664. The last of these wild herds were shot only a few years ago. They may have roamed unmolested for two hundred years since the great native chiefs Hohan Topatrapanning, Hohan Kepanectamto, Takamony and Mothant Takomis by deed perfected the title in the white grantees of the king, March 30, 1688. Or they may have been left by the fifty-two whalers who lived here one hundred and thirty-five years ago, or be the descendants of the domestic cattle of the shipbuilders who built craft here to resist the British. However they came here, they without doubt influenced the character of the growth by eating leaves and twigs and by crushing the young growth under foot. Holly disports itself peculiarly. It is not uncommon to find two hollies grown together, or a limb of one grown fast to another holly, or one limb uniting with another limb of the same tree, or joining the trunk to form the so-called "jug-handles."[19] In one instance two hollies are embracing and slowly killing a red cedar, several of the dead limbs of which have been surrounded by the trunks of the hollies. Here are countless examples of tree contention. The limbs of the hollies are matted and zigzag. The trees are full of limb-holes, favorite nesting-places for flickers, which, with the robins, are potent agents in tree distribution. This forest was at one time very dense and the underbrush a mass of green briars. Freak trees are abundant. The "Siamese Twins," two monster hollies, grow up to a height of sixty-five feet. About fifteen feet from the ground, years ago, a branch nearly a foot in diameter grew out from one tree and into the other, solidly joining them together. A short distance from the curiously joined holly trees grows "Crookedness," a cedar tree which has assumed a most fantastic shape. "Before Columbus" is a huge cedar tree nearly

[19] 1894, Gifford, "Report on Forestry," *Annual Report of N. J. State Geologist*, 1894, p. 263.

three feet in diameter, fifty feet high, with gnarled branches. "Methusaleh" is another huge cedar disputing with "Before Columbus" for preëminence as a wonder. "Contwisted" is a name given by painted signboard to two large trees with trunks one and one-half feet in diameter, twisted about each other. "Laocoon" appropriately describes an oak tree supporting an enormous liane or grapevine, *Vitis Labrusca* L. The stem of this liane is as thick as a man's leg. Another liane denominated "Giant Grapevine" is fully one foot in diameter. A magnolia tree growing up through the hollow trunk of an old cedar is another noteworthy sight. A wild cherry is called the "arch or rainbow tree," its trunk assuming the shape of a perfect half-circle. Many of the branches of the trees have been removed for rustic work. Some perfectly represent the letters of the alphabet, as x, w, z, i and o.[20] Many of the larger trees, especially the red maples, are draped with long festoons of the lichen, *Usnea barbata*, reminding one of the live oaks of the South draped with the gray Florida moss, *Tillandsia usneoides* L.

Within the area of the thicket formation are open spaces representing the depressions of the surface, as well as more elevated sandy glades. Several well-marked associations of plants, or societies, take possession of these spaces, varying in ecological composition according to the physiography.

At Seaside Park (one mile below town) several such societies can be delimited. Near the ocean front adjoining the old hotel, long since abandoned, is a hollow accommodating the cranberry and *Drosera intermedia* Hayne. Somewhat farther back is the Marsh Shield-fern society, composed almost entirely of dense growths of *Dryopteris Thelypteris* (L.) A. Gray, surrounded by jungles of Juniper, Baccharis, etc. A third hollow supports in its damp, marshy soil a dominant growth of the sedge *Scirpus debilis* Pursh., which forms the "Scirpus society." A fourth depression, removed some distance from the other, is a favorable place for the Hibiscus society, composed of three character plants, *Hibiscus moscheutos* L., *Scirpus debilis* Pursh., and *Dryopteris Thelypteris* (L.) A. Gray. Still another open space, much wetter than the others mentioned, forms a nidus for *Typha latifolia* L.,

[20] *Forest Leaves*, VII, pp. 67 and 92. Two articles describing the remarkable tree growths on Five-mile Beach.

the margin consisting of drier ground having the marsh shield-fern, *Dryopteris Thelypteris* (L.) A. Gray (Cat-tail society). The higher open sand glades are covered with clumps of *Hudsonia tomentosa* Nutt. Such an assemblage might be denominated the Hudsonia society.

This diversity is the more striking when one considers the small number of plants which enter into the composition of the different associations. The number of possible societies which might exist under the varying conditions of dune and thicket life can be determined mathematically by the rules of permutations and combinations, thus: If we have 10 plants which we wish to combine into different societies, using 6 plants for each society, we find by the rule of combinations that theoretically 210 such societies are possible. If we have 8 plants, taken 4 at a time, 70 societies are possible; if 6 plants, taken 3 at a time, theoretically 20 associations are within the possibility. This number of societies does not exist in a state of nature, because, although within a mathematical possibility, yet specific characters, the condition of the soil, air and illumination all prevent the theoretical realization of the mathematical expression of the possibility of such combinations taking place.

Occurring in the jungle of Wildwood are a number of well-defined societies classified as follows, with the names of their component character plants:

OSMUNDA SOCIETY = *Osmunda regalis* L., *Scirpus sp.*, *Impatiens biflora* Walt., *Lobelia cardinalis* L.

PTILIMNIUM SOCIETY = *Ptilimnium capillaceum* (Michx.) Hollick.

OXYPOLIS SOCIETY = *Oxypolis rigidus* (L.) Britton, *Hibiscus moscheutos* L.

POLYGONUM SOCIETY, along the borders of a swampy area = *Polygonum lapathifolium* L.

The following species also occur in the thicket formation of Wildwood, but from the notes taken it is impossible to place them in their proper association: *Asclepias pulchra* Ehrh., *Cassia chamæcrista* L., almost pure, *Dryopteris Thelypteris* (L.) A. Gray, *Triadenum virginicum* (L.) Raf., *Juncus acuminatus* Michx., *Carex lupulina* Muhl., *Cyperus strigosus* L.

B. Marsh-dune Formation.

This formation consists of rounded hills of sand, which arise from the centre of the salt marsh, are covered with a variety of shrubs and occasionally one or two trees. At Seaside Park, such elevated patches of sand support the following plant species: *Prunus maritima* Wang., *Baccharis halimifolia* L., *Iva frutescens* L., *Rosa humilis lucida* Ehrh., *Rhus radicans* L., *Juniperus virginiana* L., *Rhus copallina* L., *Myrica cerifera* L., and some herbaceous plants, as *Achillea millefolium* L., *Eupatorium rotundifolium* L.

II. Salt-marsh Vegetation.

A. Tidal-flat Formation (not studied).

B. Saline-marsh Formation.

The saline marsh at South Atlantic City was the only marsh of this class visited on the New Jersey coast, and nothing in a comparative way can be said of this formation, as it exists on the New Jersey coast in general. Most of the species collected show a xerophytic habit. *Salicornia herbacea* L., *Tissa marina* (L.) Britton, *Limonium carolinianum* (Walt.) Britton, *Juncus scirpoidea* Lam., *Juncus Gerardi* Loisel, *Spartina patens* (Ait.) Muhl., *Distichlis spicata* (L.) Greene and *Sabbatia stellaris* Pursh. are all components of the vegetation of the South Atlantic City salt marsh. In the general list at the end of the paper other species inhabitants of the New Jersey saline marshes will be given, but they are excluded from the descriptive portion, because they were not observed by the writer, and nothing can, therefore, be said of their ecological relationships. In the near future an appendix will be issued giving an account of the peculiar salt-marsh zones of the New Jersey coast.

C. Converted Saline-marsh Formation.

Formation C. consists of marsh which has been redeemed from tidal salt water by the formation of a sandy beach and a low dune along its bay side. The low dune owes its origin to the western winds which blow over the wide and shallow bays behind the beach. This dune rises usually to a height of two or three

feet and is unbroken, as it runs parallel to the bay shore. The marsh proper has been raised above the level of high tide by the blowing in of sand uniformly over its entire surface, and by the collection of humus in the soil by the decay of the vegetable covering. In very dry weather this marsh can be traversed at Seaside Park in any direction without wetting the feet; but when a rainy spell sets in, it becomes flooded with two or three inches of fresh water, which in ordinary seasons remains constantly on the surface, forming a shallow swamp. Even if the surface is not flooded, one's feet sink into the surface of the marsh sufficiently for the water to penetrate to the interior of the shoes.

The list of plants found here comprise the following species, none of which show any remarkable xerophytic adaptation, except such as is coincident with a marsh life anywhere:

Panicum amarum Ell.
Panicum proliferum Lam.
Rhyncosphora glomerata (L.) Vahl.
Juncus Gerardi Lois.
Verbena hastata L.
Limonium carolinianum (Walt.) Britton.
Gyrostachys cernua (L.) Kuntze.
Ptilimnium capillaceum (Michx.) Hollick.
Asclepias pulchra Ehrh.
Sabbatia stellaris Pursh.
Sabbatia lanceolata (Walt.) T. and G.
Gerardia purpurea L.
Hypericum canadense L.
Triadenum virginicum (L.) Raf.
Drosera intermedia Hayne.
Kosteletskya virginica (L.) A. Gray. Very commom as isolated plants, never growing in ecological groups.

This last malvaceous plant, common farther south, seems to hold its own with the other components of the converted saline-marsh formation, as the following statistical table shows:

STATISTICS OF FRUIT AND SEED PRODUCTION OF KOSTELETSKYA VIRGINICA, GRAY.[21]

The plants for this enumeration were gathered in the salt marshes at Seaside Park, N. J.

The ratio of the perfect to the abortive seeds is given.

[21] 1898, Harshberger, "Statistical Information Concerning the Production of Fruits and Seeds in Certain Plants," *Contrib. Bot. Lab. Univ. of Pa.*, Vol. II, p. 102.

Number of Plant.	Number of Capsule.	CAPSULE NUMBER.																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Plant 1	5	5	3	5	3 : 2	1 : 3	–	–	—	—	—	—	—	—	—	–	–	–	—	–	–	–	–
" 2	14	5	5	3	5	5	3	5	3 : 2	5	1 : 4	5	0 : 5	4	3	–	–	–	—	–	–	–	–
" 3	12	1 : 3	–	5	5	4	5	5	4 : 1	4	5	5	5	—	—	–	–	–	—	–	–	–	–
" 4	13	5	5	5	4	0 : 4	5	4	2 : 2	3	5	2 : 3	4 : 1	1 p.	—	–	–	–	—	–	–	–	
" 5	22	3 : 1	5	4 : 1	5	5	4	4	4	4	3 : 2	4	2 : 2	5	5	5	4	5	3 : 2	2	4	4	–
" 6	18	4	5	5	4	5	5	5	5	4 : 1	5	5	5	4	2 p.	5	2	5	5	–	–	–	–

Hibiscus moscheutos L. forms societies over extensive areas to the exclusion of most other plants. This plant grows abundantly at Seaside Park, on the west side of the railroad at Fourteenth avenue, covering several acres, and when in full flower is a remarkable sight worth a long journey to see. The large bell-shaped flowers, three and four inches across, are of a bright pink or white color, through albinism. The plants grow so thickly that at a distance the meadows seem one mass of color, and this predominance is due to the large number of seeds produced.

STATISTICS OF FRUIT AND SEED PRODUCTION OF HIBISCUS MOSCHEUTOS, L.[22]

The ripe capsules on a number of plants of this species were counted in 1894 at Seaside Park, N. J., where it grows abundantly in the salt-water marshes. The results statistically are displayed in the subjoined table (p = pierced by larvæ):

No. of Plant	CAPSULES. One. Seeds. Per-fect.	One. Seeds. Abor-tive.	One. No. of Cells.	Two. Seeds. Per-fect.	Two. Seeds. Abor-tive.	Two. No. of Cells.	Three. Seeds. Per-fect.	Three. Seeds. Abor-tive.	Three. No. of Cells.	Four. Seeds. Per-fect.	Four. Seeds. Abor-tive.	Four. No. of Cells.	Five. Seeds. Per-fect.	Five. Seeds. Abor-tive.	Five. No. of Cells.	Six. Seeds. Per-fect.	Six. Seeds. Abor-tive.	Six. No. of Cells.
1	71	55	3	137	14	4	117	30	5	102	46	5	—	—	-	—	—	-
2	82	34	5	105	11	5	*47	64	4	82	36	5	—	—	-	—	—	-
3	68	23	5	*40	51	5	52	46	5	51	49	5	*38	57	5	—	—	-
4	113	5+12 p	5	*49	57	5	—	—	-	—	—	-	—	—	-	—	—	-
5	107	15	5	88	33	5	114	12	5	78	39	5	110	10	5	110	16	5
6	*50	70	5	61	61	-	113	12	5	115	10	5	—	—	-	—	—	-
7	59	53	5	84	25	5	105	4	5	97	5	5	87	11	5	—	—	-
8	115	1	5	110	1+15 p	5	46	36	5	109	14	5	—	—	-	—	—	-

The slues at Seaside Park, where at every high tide the brackish waters of the bay pass into a channel leading to a lower part of the meadow, are breeding places for mosquitoes and the haunts of the mud turtle. Along their edges grow *Baccharis halimifolia* L., *Iva frutescens* L. and *Scirpus robustus* Pursh., the salt-marsh bulrush, and floating upon the surface of the water a mass of *Scirpus nanus* Spreng. torn away by tidal action from the undermined bank.

III. Bay-strand Vegetation.

A. Bay-dune Formation.

The dune along the bay at Seaside Park has, as said before, been formed by the action of western winds in piling up the sand along the bay front. It consists of loose sand, and upon its top and slopes flourish a considerable number of plants found nowhere

[22] Harshberger, *l.c.*, p. 105.

else on Barnegat Beach. These peculiar plants are therefore of ecological interest. One mile below Seaside Park on the bay side, opposite the Island Beach Life Saving Station, the bay dune and its vegetation merges itself insensibly with the thicket formation proper. In fact, no line of demarcation can be drawn at that point, where the height of the dune rises four or five feet above tide level. The bay dune supports, among other plants, *Baccharis halimifolia* L., *Iva frutescens* L., *Teucrium canadense* L., *Ammophila arenaria* (L.) Link which binds the sand, but is not a character plant, *Rhus radicans* L., with common prolification of the inflorescence, *Rosa humilis* Marsh., an extremely spinous form, and *Convolvulus sepium* L. trailing over the ground and climbing up over the higher plants.

B. Bay-beach Formation.

This formation and its ecological constitution was studied only at Seaside Park. At exceptionally high tides the whole beach is subject to tidal action, but ordinarily, high-water mark is removed several feet from the limit of vegetation. Along Barnegat Bay large quantities of eel-grass, *Vallisneria spiralis* L., is washed ashore. At low-tide mark it is still green, but at high-tide mark it has become dry, hay-like, and of a chocolate-brown color. The supply is derived from the fresh-water rivers which empty into Barnegat Bay. The dried plant is gathered by the cartload and spread upon graded areas to prevent the action of the wind upon the sand. The high beach, out of reach of ordinary tides, supports the following plants: *Amaranthus retroflexus* L., *Suæda linearis* var. *ramosa* S. Wats., *Chenopodium album* L., *Salsola kali* L., *Atriplex hastata* L., *Cakile edentula*(Bigel.) Hook., *Xanthium canadense* Mill., *Erechtites hieracifolia* (L.) Raf. and *Spartina patens* (Ait.) Muhl., which is extremely abundant. All of these are xerophytes and are mostly succulents, provided in this way against the danger of death by transpiration. The only plant of doubtful xerophytic habit is *Erechtites hieracifolia* (L.) Raf. Its morphological appearance belies the possibility of its occurrence on this beach, constantly bathed by salt water—it is true somewhat diluted by the fresh water of the rivers, but nevertheless strongly saline.

IV. Bay-water Vegetation.

(*a*) *The Plankton* (not investigated).

(*b*) *Ruppia Zone.*

Ruppia maritima L. grows in the salt and brackish waters of Barnegat Bay, just beyond the bay-beach wave action. The plant is anchored in the sandy bottom, and at low tide floats in about twelve to eighteen inches of water. It is a graceful plant, as it moves backward and forward by wave action. The pollen from the two naked flowers of the spike is discharged, as geniculate, cylindrical grains, which float to the surface, and are carried by the water to the pistillate flowers with sessile, peltate stigmas, which now reach the surface at the end of a coiled peduncle and are ready to receive the pollen carried by the wind. After fertilization, the fruit which begins to form is drawn below the surface of the water by the coiling peduncle.

(*c*) *Nereid Zone* (not investigated), comprising those algæ attached to the piles of landings or jetties, especially in the neighborhood of the inlets.

This survey endeavors to present the fundamental facts concerning the zonal distribution of the New Jersey strand plants and their ecological relationship. A more detailed inspection of the entire coast would doubtless reveal other peculiarities of the sea-beach flora, but it is believed and hoped that the descriptive account given above presents an outline sketch of the more important facts relating to the sand-strand vegetation of New Jersey.

Phyto-Geography.

The affinities of the New Jersey coast flora may be briefly summed up by presenting in the following list the range of some of the character plants which have been referred to in the above ecological description. Of the total number of species of plants collected, 228 in number, 5 are pteridophytes, 2 conifers, 66 monocotyledons, and 155 dicotyledons, as compared with 135 plants collected by Kearney on Ocracoke Island, N. C.

1. The following plants of the New Jersey strand flora have been collected on Presque Isle, Lake Erie:[23]

Ammophila arenaria (L.) Link. *Lathyrus maritimus* (L.) Bigel.

[23] Porter, T. C., *Rare Plants of Southeastern Pennsylvania*, Meh., 1900.

Sieglingia purpurea (Walt.) Ktze.
Cakile edentula (Bigel.) Hook.
Euphorbia polygonifolia L.
Strophostyles helvola (L.) Britt.
Hibiscus moscheutos L.

2. The dunes of Lake Michigan[21] are occupied by the following Atlantic coast plants:

Cakile edentula (Bigel.) Hook.
Euphorbia polygonifolia L.
Ammophila arenaria (L.) Link.
Polygonum ramossissimum Michx.
Lathyrus maritimus (L.) Bigel.
Hudsonia tomentosa Nutt.
Rhus copallina L.
Lespedeza capitata Michx.
Monarda punctata L.

3. Species of plants found on the New Jersey coast and ranging southward to North Carolina and Florida:

Juniperus virginiana L.
Typha latifolia L.
Spartina patens (Ait.) Muhl.
Distichlis spicata (L.) Greene.
Cyperus nuttallii Eddy.
Juncus scirpoides Lam.
Myrica cerifera L.
Atriplex hastata L.
Salicornia herbacea L.
Salsola kali L.
Sesuvium maritimum (Walt.) B. S. P.
Tissa marina (L.) Britton.
Meibomia paniculata (L.) Kuntze.
Linum medium (Planch.) Britton.
Euphorbia polygonifolia L.
Rhus radicans L.
Ilex opaca Ait.
Vitis æstivalis Michx.
Kosteletskya virginica.
Hibiscus moscheutos L.
Œnothera humifusa Nutt.
Limonium carolinianum (Walt.) Britton.
Monarda punctata L.
Gerardia maritima Raf.
Solidago sempervirens L.
Baccharis halimifolia L.
Pluchea camphorata (L.) D. C.
Iva frutescens (L.) Raf.
Carduus spinosissimus Walt.

4. Species ranging northward. The northern limit is taken from Britton and Brown's *Illustrated Flora:*

Spartina patens (Ait) Muhl. (Nova Scotia).
Distichlis spicata (L.) Greene (Maine).
Iva frutescens L. (Massachusetts).
Solidago sempervirens L. (New Brunswick).

[21] Cowles, *l. c.*

Sesuvium maritimum (Walt.) B. S. P. (New York).
Euphorbia polygonifolia L. (Rhode Island).
Kosteletskya virginica (L.) A. Gray. (New York).
Limonium carolinianum (Muhl.) Britton (Labrador).
Aster subulatus Michx. (New Hampshire).
Baccharis halimifolia L. (Massachusetts).
Hudsonia tomentosa Nutt. (New Brunswick).
Lechea maritima Leg. (Massachusetts).

5. Species occurring also on the sea coast of the northern hemisphere in the Old World:[25]

Spartina stricta (Ait.) Roth.
Atriplex hastata L.
Salicornia herbacea L.
Salsola kali L.
Tissa marina (L.) Britton.
Ammophila (*Psamma*) *arenaria* (L.) Link.
Lathyrus maritimus (L.) Bigel.

6. The plants which may be said to have been recently introduced and to occur here, as elsewhere, as weeds are:

Holcus lanatus L.
Oenothera laciniata Hill.
Daucus carota L.
Achillea millefolium L.
Ambrosia artemisiæfolia L.
Anthemis cotula D. C.
Carduus arvensis (L.) Robs.
Lactuca canadensis L.
Leptilon canadensis (L.) Britton and others.

7. The following plants, mentioned in the descriptive text, also occur on the dune formations near the Lake of the Woods:[26]

Hudsonia tomentosa Nutt.
Rhus radicans L.
Lathyrus maritimus (L.) Bigel.

List of Plants.

This list comprises the names of those plants known to occur on the beaches and salt marshes of the New Jersey coast. It is made as complete as possible, so that the plants peculiar to the region are brought together for ready reference. The nomenclature used is that found in Britton and Brown's *Illustrated Flora of the Northern United States, Canada and the British Possessions*, but for purposes of comparison the names according to Gray's *Manual of*

[25] Kearney, *l. c.*, p. 313.
[26] MacMillan, "Observations on the Distribution of Plants Along Shore at Lake of Woods," *Minn. Bot. Studies Bulletin*, 9, p. 949.

Botany (sixth edition, 1890) are given in parentheses. The source of information is designated as follows: Unmarked, collections made by the writer at Seaside Park, July 19, 20 and 21; at South Atlantic City and Ocean City on August 21; at Wildwood, August 31, 1900; marked by asterisk (*), plants collected by members of the Philadelphia Botanical Club;[27] with a dagger (†), plant names given in Britton's *Catalogue of New Jersey Plants.*[28] In all cases omitting the dates, the locality where the species were found is given by way of geographically fixing the plants. A large number of plants from Wildwood in the herbarium of the Philadelphia Botanical Club were collected July 4, 1897. When only one name is given without accompanying synonym, it is common to the manuals mentioned above.

OPHIOGLOSSACEÆ.

*Ophioglossum arenarium E. G. Britton. Wildwood.

OSMUNDACEÆ.

Osmunda regalis L. Wildwood.

POLYPODIACEÆ.

Dryopteris marginalis (L.) A. Gray (*Aspidium marginale* Sw.). Seaside Park.

Dryopteris thelypteris (L.) A. Gray (*Aspidium thelypteris* Sw.). Seaside Park, Ocean City, Wildwood.

Pteris aquilina L. South Atlantic City.

CONIFERÆ.

Pinus rigida Mill. Seaside Park, South Atlantic City.

Juniperus virginiana L. Seaside Park (6 varieties), South Atlantic City, Wildwood.

TYPHACEÆ.

Typha latifolia L. Seaside Park.

NAJADACEÆ.

Ruppia maritima L. Seaside Park. †Brackish water, common.

†Zostera marina L.

[27] For names of collectors the investigator is referred to the labels on the herbarium sheets at the Acad. Nat. Sci. of Phila.

[28] The marks of designation, when a species collected by the writer are also mentioned in the two floras, are placed before the name of the locality instead of before the name of the plant.

ALISMACEÆ.

*Alisma plantago-aquatica L. Cape May.

GRAMINEÆ.

*Agrostis alba L. Wildwood

*Aira præcox L. Anglesea.

Ammophila arenaria (L.) Link. (*Ammophila arundinacea* Host.). Seaside Park, South Atlantic City, Ocean City, Wildwood, *Cape May.

Andropogon virginicus L. Wildwood.

*Aristida purpurascens Poir. Anglesea.

*Bromus asper Murr. (*Bromus asper* L.). Wildwood.

Cenchrus tribuloides L. Ocean City, *Wildwood. †Sandy soil on sea beaches.

Distichlis spicata (L.) Greene (*Distichlis maritima* Raf.). South Atlantic City, *Atlantic City. †Salt meadows, common.

*Diplachne fascicularis (Lam.) Beauv. (*D. fascicularis* Beauv.). Sea Isle City.

*Festuca ovina L. Wildwood.

*Festuca ovina var. duriuscula (L.) Hack. (*F. ovina* var. *duriuscula* Koch). Holly Beach.

*Holcus lanatus L. Wildwood.

*Muhlenbergia diffusa Schreb. Anglesea.

*Panicularia fluitans (L.) Kuntze (*Glyceria fluitans* R. Br.). Anglesea.

Panicum amarum Ell. Seaside Park, Wildwood.

*Panicum barbulatum Michx. Wildwood.

*Panicum columbianum Scribner. Wildwood.

Panicum crus-galli var. hispidum (Muhl.) Torr. Seaside Park, *Sea Isle City. †Salt or brackish marshes, common.

Panicum proliferum Lam. Seaside Park. †Common along borders of salt or brackish meadows.

*Panicum verrucosum Muhl. Anglesea.

Panicum virgatum L. Seaside Park, Wildwood.

*Panicum viscidum Ell. Five-mile Beach.

†Savastana odorata (L.) Scribn. (*Hierochloë borealis* R. and S.). Borders of salt or brackish meadows. Seabright.

Sieglingia purpurea (Walt.) Kuntze (*Triodia purpurea* Hack.). Seaside Park, *Atlantic City. †Common on sea beaches.

Spartina cynosuroides (L.) Willd. (*Spartina cynosuroides* Willd.). Ocean City, Longport.

Spartina patens (Ait.) Muhl. (*S. juncea* Willd.). Seaside Park, South Atlantic City, *Sandy Hook, *Anglesea, *Wildwood *Cape May. †On salt marshes, common.

Spartina polystachya (Michx.) Ell. (*S. polystachya* Willd.). Seaside Park. †Salt marshes, common.

*SPARTINA STRICTA MARITIMA (Walt.) Scribn. (*S. stricta* var. *glabra* Gray). Cape May. †Ditches, salt marsh, common. *Seaside Park, *Atlantic City, *Cape May.

CYPERACEÆ.

CAREX LUPULINA Muhl. Wildwood, *Five-mile Beach.

CAREX MONILIFORMIS (Tuck.) Britton (?). †Sea beaches, common.

†CAREX MUHLENBERGII Schk. Atlantic City.

*CAREX PSEUDO-CYPERUS L. var. AMERICANA Hochst. (*Carex comosa* Boott.). Five-mile Beach.

†CAREX ALATA Torr. (*Carex straminea* Schk. var. *alata* (Torr.) Bailey). Atlantic City, Cape May.

†CAREX ALBOLUTESCENS Schwein (*Carex straminea* Schk. var. *fœnea* (Willd.) Torr.). Edges salt or brackish marshes, common.

*CAREX VIRESCENS Muhl. Wildwood.

*CYPERUS CYLINDRICUS (Ell.) Britton (*Cyperus Torreyi* Britton). Wildwood.

†CYPERUS GRAYII Torr. Sea beaches, common.

CYPERUS NUTTALLII Eddy (*C. Nuttallii* Torr.). Seaside Park, Ocean City, *Cape May. †Salt or brackish marshes.

CYPERUS STRIGOSUS L. Wildwood.

*ELEOCHARIS OVATA (Roth.) R. and S. (*E. ovata* R. Br.). Anglesea.

FIMBRYSTYLIS CASTANEA (Michx.) Vahl. (*F. spadicea* var. *castanea* Gray). *Anglesea, *Sea Isle City, *Cape May. Salt or brackish marshes.

*FUIRENA SQUARROSA Michx. Cape May.

FUIRENA SQUARROSA HISPIDA (Ell.) Chapm. *Cape May, †Ocean Beach.

RHYNCHOSPORA GLOMERATA (L.) Vahl. (*R. glomerata* Vahl.). Seaside Park.

*SCIRPUS AMERICANUS Pers. (*S. pungens* Vahl.). Wildwood.

SCIRPUS DEBILIS Pursh. Seaside Park.

*SCIRPUS LACUSTRIS L. Anglesea.

†SCIRPUS NANUS Spreng. Salt or brackish meadows.

SCIRPUS ROBUSTUS Pursh. (*S. maritimus* L.). Seaside Park, *Holly Beach, *Anglesea.

XYRIDACEÆ.

*XYRIS FLEXUOSA Muhl. Anglesea.

JUNCACEÆ.

JUNCUS ACUMINATUS Michx. Wildwood, *Holly Beach.

*JUNCUS BUFONIUS L. Wildwood.

JUNCUS EFFUSUS L. Seaside Park.

JUNCUS GERARDI Loisel. Seaside Park, South Atlantic City, *Holly Beach, *Atlantic City.

*JUNCUS MARGINATUS Rostk. Wildwood.

†JUNCUS ROEMERIANUS Scheele. Brackish marshes New Jersey; reported by Pursh, but not found certainly since.

JUNCUS SCIRPOIDES Lam. South Atlantic City.

*JUNCUS TENUIS Willd. Holly Beach.

LILIACEÆ.

SMILAX ROTUNDIFOLIA L. Seaside Park.

*LILIUM SUPERBUM L. Cape May.

*POLYGONATUM COMMUTATUM (R. and S.) Dietr. (*P. giganteum* Dietr.). Five-mile Beach.

ORCHIDACEÆ.

GYROSTACHYS PRÆCOX (Walt.) Kuntze (*Spiranthes præcox* Wats.). Seaside Park, *Anglesea.

MYRICACEÆ.

MYRICA CERIFERA L. Seaside Park, South Atlantic City, Ocean City, Wildwood, *Atlantic City.

FAGACEÆ.

QUERCUS ALBA L. × *Q. minor* (Marsh.) Sarg. Wildwood.

QUERCUS DIGITATA (Marsh.) Sarg. (*Q. falcata* Michx.). South Atlantic City, Wildwood.

QUERCUS MINOR (Marsh.) Sarg. (*Q. stellata* Wang.). South Atlantic City, Wildwood.

QUERCUS NANA (Marsh.) Sarg. (*Q. ilicifolia* Wang.). Seaside Park.

QUERCUS PHELLOS L. Seaside Park.

POLYGONACEÆ.

*POLYGONUM DUMETORUM L. Anglesea.

*POLYGONUM SCANDENS L. (*P. dumetorum* var. *scandens* Gray). Holly Beach.

*POLYGONUM ERECTUM L. Anglesea.

POLYGONUM HYDROPIPEROIDES Michx. Seaside Park.

POLYGONUM LAPATHIFOLIUM L. Wildwood.

†POLYGONUM MARITIMUM L. Sandy sea beaches.

POLYGONUM RAMOSSISSIMUM Michx. *Sea Isle, †Cape May, †Atlantic City.

*RUMEX BRITANNICA L. Holly Beach, Anglesea.

†RUMEX PERSICARIOIDES L. (*R. maritimus* L.). Salt marshes, not rare.

*RUMEX SALICIFOLIUS Weinm. Wildwood.

CHENOPODIACEÆ.

ATRIPLEX ARENARIA Nutt. Wildwood, *Anglesea, *Ocean City, *Cape May. ‡Sea beaches, common.

ATRIPLEX HASTATA L. (*A. patulum* L. var. *hastatum* Gray). Seaside Park.

CHENOPODIUM ALBUM L. Seaside Park.

†CHENOPODIUM LEPTOPHYLLUM (Moq.) Nutt. (*C. leptophyllum* Nutt.). Atlantic City, Sandy Hook. Adventive from west.

†CHENOPODIUM RUBRUM L. Salt meadows.

DONDIA AMERICANA (Pers.) Britton (*Suæda linearis* Moq.). Seaside Park, *Ocean City, *Sea Isle City, *Cape May.

†SALICORNIA AMBIGUA Michx. Wet sands of seashore. *Atlantic City.

SALICORNIA HERBACEA L. South Atlantic City, *Sea Isle City.

†SALICORNIA BIGELOVII Torr. (*S. mucronata* Bigel.). Salt meadows.

SALSOLA KALI L. Seaside Park, Wildwood, *Atlantic City, *Cape May.

AMARANTACEÆ.

†ACNIDA CANNABINA L. Brackish marshes.

†AMARANTHUS PUMILUS Raf. Sandy sea beaches, frequent.

AMARANTHUS RETROFLEXUS L. Seaside Park.

AIZOACEÆ.

SESUVIUM MARITIMUM (Walt.) B.S.P. (*S. pentandrum* Ell.). Wildwood. †Sea beaches, frequent. *Ocean City.

CARYOPHYLLACEÆ.

AMMODENIA PEPLOIDES (L.) Rupr. (*Arenaria peploides* L.). Seaside Park, *Atlantic City, *Anglesea.

MŒHRINGIA LATERIFLORA (L.) Fenzl. (*Arenaria lateriflora* L.). *Anglesea, *Atlantic City, †Anglesea.

*SAGINA DECUMBENS (Ell.) T. and G. Wildwood.

TISSA MARINA (L.) Britton (*Buda marina* Dumort). South Atlantic City, *Cape May, *Holly Beach. †Salt or brackish marshes, common.

*TISSA RUBRA (L.) Britton (*Buda rubra* Dumort). Sea Isle City, Atlantic City.

MAGNOLIACEÆ.

MAGNOLIA VIRGINIANA L. (*M. glauca* L.). Wildwood.

RANUNCULACEÆ.

†Oxygraphis cymbalaria (Pursh.) Prantl. (*Ranunculus cymbalaria* Pursh.). Borders of salt marsh, Atlantic City.

LAURACEÆ.

Sassafras sassafras (L.) Karst. (*S. officinale* Nees). Seaside Park, Wildwood.

CRUCIFERÆ.

Cakile edentula (Bigel.) Hook. (*C. americana* Nutt.). Seaside Park, *Cape May, *Anglesea, *Sea Isle City.

DROSERACEÆ.

Drosera filiformis Raf. Seaside Park.
Drosera intermedia Hayne. Seaside Park.

ROSACEÆ.

Prunus maritima L. Seaside Park, Wildwood, *Five-mile Beach.
Prunus serotina Ehrh. Wildwood.
Rosa carolina L. Seaside Park, Wildwood.
Rosa humilis Marsh. Seaside Park, *Five-mile Beach.
Rubus canadensis L. Seaside Park.

LEGUMINOSÆ.

Cassia chamæcrista L. South Atlantic City, Wildwood.
Lathyrus maritimus (L.) Bigel. Seaside Park.
Lespedeza capitata Michx. Wildwood.
Meibomia paniculata (L.) Kuntze (*Desmodium paniculatum* D. C.). Wildwood.
Strophostyles helvola (L.) Britton (*S. angulosa* Ell.). Ocean City, Wildwood.

GERANIACEÆ.

†Geranium Robertianum L. In old forest, Sandy Hook.

LINACEÆ.

Linum medium (Planch.) Britton. Seaside Park.

POLYGALACEÆ.

†Polygala cruciata L. Abundant along the borders of salt marshes with upland.

EUPHORBIACEÆ.

†EUPHORBIA HUMISTRATA Engelm.

EUPHORBIA POLYGONIFOLIA L. Seaside Park, *Wildwood, *Cape May.

ANACARDIACEÆ.

RHUS COPALLINA L. Seaside Park, *Cape May.

RHUS RADICANS L. (*Rhus toxicodendron*). Seaside Park.

AQUIFOLIACEÆ.

ILEX OPACA Ait. Seaside Park, South Atlantic City (form with spineless leaves), Wildwood.

ACERACEÆ.

ACER RUBRUM L. Wildwood.

BALSAMINACEÆ.

IMPATIENS BIFLORA Walt. (*I. fulva* Nutt.). Wildwood.

VITACEÆ.

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch. (*Ampelopsis quinquefolia* Michx.). Seaside Park.

VITIS ÆSTIVALIS Michx. South Atlantic City, Ocean City.

VITIS LABRUSCA L. Wildwood, forming lianes; stem over one foot in diameter.

MALVACEÆ.

HIBISCUS MOSCHEUTOS L. Seaside Park, Wildwood, *Cape May.

KOSTELETSKYA VIRGINICA (L.) A. Gray. Seaside Park.

GUTTIFERÆ.

HYPERICUM CANADENSE L. Seaside Park.

HYPERICUM MUTILUM L. Seaside Park.

TRIADENUM VIRGINICUM (L.) Raf. (*Elodes campanulata* Pursh.). Seaside Park, *Cape May.

CISTACEÆ.

HUDSONIA TOMENTOSA Nutt. Seaside Park, *Five-mile Beach, *Atlantic City.

LECHEA MARITIMA Leggett (*L. minor* var. *maritima* A. Gray). Seaside Park. †Sands of seashore, common.

LYTHRACEÆ.

†LYTHRUM LINEARE L. Borders of salt marshes.

MELASTOMACEÆ.

*Rhexia mariana L. Cape May.
*Rhexia virginica L. Anglesea, Cape May.

ONAGRACEÆ.

Œnothera humifusa Nutt. Wildwood.
*Œnothera laciniata Hill (*Œ. sinuata* L.). Five-mile Beach.
*Kneiffia pumila (L.) Spach. (*Œnothera pumila* L.). Five-mile Beach.

HALLORAGINACEÆ.

*Myriophyllum pinnatum (Walt.) B. S. P. (*M. scabratum* Michx.). Shallow ditches, Wildwood.

UMBELLIFERÆ.

*Eryngium virginianum Lam. Cape May.
*Caucalis anthriscus Hudson. Wildwood.
*Hydrocotyle verticillata Thunb. Wildwood.
*Hydrocotyle umbellata L. Cape May.
Oxypolis rigidus (L.) Britton (*Tiedemannia rigida* Coult. and Rose). Wildwood, *Anglesea.
Ptilimnium capillaceum (Michx.) Hollick (*Discopleura capillacea* D. C.). Seaside Park, Ocean City, Wildwood, *Five-mile Beach.
Sium cicutæfolium Gmel. Five-mile Beach.

CORNACEÆ.

Nyssa sylvatica Marsh. Wildwood.

ERICACEÆ.

Kalmia angustifolia L. Seaside Park.
Oxycoccus macrocarpus (Ait.) Pers. (*Vaccinium macrocarpon* Ait.). Seaside Park.
Vaccinium atrococcum (A. Gray) Heller (*V. corymbosum* var. *atrococcum* A. Gray). Seaside Park.
Vaccinium corymbosum L. Seaside Park.

PRIMULACEÆ.

†Glaux maritima L. Deal Beach.
*Trientalis americana Pursh. Anglesea.
*Anagallis arvensis L. Cape May.
*Samolus floribundus H. B. K. (*S. valerandi* var. *americanus* Gray). Five-mile Beach.

PLUMBAGINACEÆ.

LIMONIUM CAROLINIANUM (Walt.) Britton (*Statice limonium* var. *carolinianum* A. Gray). Seaside Park, South Atlantic City, *Ocean City, *Cape May.

GENTIANACEÆ.

*SABBATIA ANGULARIS (L.) Pursh. Wildwood, Cape May.

†SABBATIA CAMPANULATA (L.) Torr. (*Sabbatia gracilis* Salisb.). Ocean Beach, Ocean Grove, Cape May.

SABBATIA LANCEOLATA (Walt.) T and G. Seaside Park.

SABBATIA STELLARIS Pursh. Seaside Park, South Atlantic City, *Cape May.

ASCLEPIADACEÆ.

ASCLEPIAS PULCHRA Ehrh. (*A. incarnata* var. *pulchra* Pers.). Seaside Park, Wildwood.

CONVOLVULACEÆ.

CONVOLVULUS SEPIUM L. Seaside Park.

VERBENACEÆ.

LIPPIA LANCEOLATA Michx. Wildwood.

VERBENA HASTATA L. Seaside Park.

LABIATÆ.

LYCOPUS AMERICANUS Muhl. (*L. sinuatus* Ell.). Wildwood.

MONARDA PUNCTATA L. Ocean City, *Cape May, Wildwood.

TEUCRIUM CANADENSE L. Seaside Park, *Anglesea.

SOLANACEÆ.

LYCOPERSICON LYCOPERSICON (L.) Karst (*Lycopersicum esculentum* Miller). Wildwood, in beach sand; evidently introduced by fruit brought as luncheon.

SCROPHULARIACEÆ.

GERARDIA PURPUREA L. Seaside Park, Ocean City, Wildwood, *Cape May.

*GERARDIA MARITIMA Raf. Sea Isle City, Ocean City, Atlantic City, Cape May.

GRATIOLA PILOSA Michx. Cape May.

PLANTAGINACEÆ.

*PLANTAGO VIRGINICA L. Anglesea.

*PLANTAGO MARITIMA L. Atlantic City.

RUBIACEÆ.

*Diodia virginiana L. Cape May.

CAPRIFOLIACEÆ.

*Lonicera sempervirens L. Anglesea.
Viburnum dentatum L. South Atlantic City.

CAMPANULACEÆ.

Lobelia cardinalis L. Wildwood.
Lobelia puberula Michx. Cape May.

COMPOSITÆ.

Achillea millefolium L. Seaside Park.
Ambrosia artèmisiæfolia L. Wildwood.
Anaphalis margaritacea (L.) Benth. and Hook. Wildwood.
*Anthemis cotula D.C.
†Artemisia stelleriana Bess. Sea beaches, Sandy Hook.
*Aster lateriflorus (L.) Britton (*Aster diffusus* L.) Sea Isle City.
*Aster lateriflorus thyrsoideus A. Gray (*A. diffusus thyrsoideus* Gray). Sea Isle City.
*Aster tenuifolius L. (*A. flexuosus* Nutt.). Cape May, Ocean City, Atlantic City.
*Aster subulatus L. (*A. linifolius* Gray). Cape May, Wildwood.
Baccharis halimifolia L. Seaside Park, *Cape May.
Bidens connata Muhl. Ocean City.
*Bidens lævis (L) B. S. P. (*B. chrysanthemoides* Michx.). Cape May.
*Carduus arvensis (L.) Robs. (*Cnicus arvensis* Hoff.). Anglesea.
Carduus spinosissimus Walt. (*Cnicus horridulus* Pursh.). Seaside Park. †Junction salt or brackish marshes and upland.
*Chrysopsis mariana Nutt. Cape May.
Erechtites hieracifolia (L.) Raf. Seaside Park.
*Eupatorium album L. Anglesea.
*Eupatorium cœlestinum L. Cape May.
Eupatorium hyssopifolium L. Wildwood, *Cape May.
Eupatorium rotundifolium L. Seaside Park, Atlantic City.
Helianthus giganteus L. Wildwood.
Hieracium marianum Willd. Five-mile Beach.
*Ionactis linariifolius (L.) Greene (*Aster linariifolius* L.). Cape May.
Iva frutescens L. Seaside Park, *Atlantic City.

LACTUCA CANADENSIS L. Wildwood, *Holly Beach.

*LACTUCA FLORIDANA (L.) Gaertn. Anglesea.

†LACTUCA HIRSUTA Muhl. Atlantic City.

*LACINARIA SQUARROSA (L.) Hill (*Liatris squarrosa* Willd.). Anglesea.

LIATRIS SPICATA (L.) Willd. (*L. spicata* Willd.). Bay Head.

LEPTILON CANADENSIS (L.) Britton (*Erigeron canadensis* L.). Wildwood.

PLUCHEA CAMPHORATA (L.) D. C. Seaside Park, *Atlantic City, *Ocean City, *Cape May.

SOLIDAGO FISTULOSA Mill. (*S. pilosa* Walt.). Wildwood.

SOLIDAGO ODORA Ait. Wildwood.

SOLIDAGO SEMPERVIRENS L. Seaside Park, Wildwood, *Ocean City.

*SOLIDAGO STRICTA Ait. Anglesea.

WILLUGHBÆA SCANDENS (L.) Kuntze (*Mikania scandens* Willd.). Ocean City, Wildwood.

XANTHIUM CANADENSE Mill. Seaside Park.

XANTHIUM CANADENSE var. ECHINATUM Gray. Wildwood.